BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA

DOCKET NO. 2023-388-E

In the Matter of: Application of Duke Energy Carolinas, LLC for Authority to Adjust and Increase its Electric Rates and Charges	))))))	**DIRECT TESTIMONY OF BENNETT D. FOGG FOR DUKE ENERGY CAROLINAS, LLC**

I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Bennett D. Fogg. My business address is 411 Fayetteville Street, Raleigh, North Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by Duke Energy Carolinas, LLC ("DEC" or the "Company") as Director of Transmission Asset Management. DEC provides various services to affiliated companies of Duke Energy Corporation ("Duke Energy").

Q. PLEASE BRIEFLY DESCRIBE YOUR DUTIES AS DIRECTOR OF TRANSMISSION ASSET MANAGEMENT.

A. My current responsibility is to provide strategic planning for Transmission Grid reliability improvement projects and programs across Duke Energy.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL QUALIFICATIONS.

A. I have a Bachelor of Science degree in Electrical Engineering and a Bachelor of Science degree in Computer Engineering from North Carolina State University. I am a registered Professional Engineer in the state of North Carolina. I have worked over 17 years in the electric utility business, with experience in electric generation, distribution, and transmission. I began working at Duke Energy in 2009, joining one of its predecessor companies, Progress Energy. Over the past seven years I have held leadership roles in the Transmission organization related to engineering design, compliance, and reliability improvements.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA ("COMMISSION") OR ANY OTHER REGULATORY BODIES?

A. No.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. I am testifying as an expert witness in this case supporting ongoing transmission operations. In my capacity as the witness supporting ongoing transmission operations, I describe and support the DEC existing transmission system, the operation and performance of the transmission system, and the costs necessary to operate and maintain it. Additionally, I describe and support the transmission investments made pursuant to the Company's Grid Improvement Plan.

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. Following the introduction above, my testimony is organized as follows:

I. First, I provide a description of DEC's transmission system, describing notable investments made in our system since the Company's last rate case in South Carolina.

II. Following, I describe the Company's Grid Improvement Plan transmission investments and the associated operational benefits achieved through the program to date. My testimony on the Grid Improvement Plan is meant to be read in conjunction with Witness Brent Guyton's testimony, who describes the Grid Improvement Plan distribution investments and outlines Grid Improvement Plan

stakeholder engagement efforts since the Company's last rate case in South Carolina.

Q. ARE YOU PROVIDING ANY EXHIBITS WITH YOUR TESTIMONY?

A. Yes. I have attached one exhibit, Fogg Direct Exhibit 1: South Carolina Grid Improvement Plan Program Summaries. This exhibit describes the transmission-related programs undertaken as part of our Grid Improvement Plan activities since our last general rate case, the costs of which are reflected in this rate case.

Q. WAS THIS DIRECT EXHIBIT PREPARED OR PROVIDED HEREIN BY YOU OR UNDER YOUR DIRECTION AND SUPERVISION?

A. Yes.

Q. IS THE INFORMATION INCLUDED IN THIS EXHIBIT SPECIFIC TO SOUTH CAROLINA?

A. No. While the costs the Company is seeking to recover in this case are the allocable share of the South Carolina retail jurisdiction, I think it is important for the Commission to see the total costs and benefits associated with these investments across the DEC system. Unlike the distribution system, the transmission grid is a highly interconnected system spanning multiple states and South Carolina customers benefit from, and are impacted by, investments across the grid. Therefore, I believe it is important to show this view as we think of the impacts to and needs of customers in South Carolina.

Q. PLEASE PROVIDE AN EXECUTIVE SUMMARY OF YOUR TESTIMONY.

A. DEC serves approximately 658,000 customers in South Carolina through a multi-state electric system that includes nearly 13,000 miles of transmission lines and nearly 1,100 substations that supports a peak load of over 20,000 MWs. South Carolina is experiencing significant economic development and the Company is focused on making sure it is investing in its grid and upgrading its infrastructure where appropriate to meet the growing demand on our system as more businesses and residents decide to locate in the state.

As part of the Company's commitment to reliably serve customers and continually improve operations, DEC has invested $1.8 billion in electric plant in service for transmission infrastructure over the last five years across the system. Maintenance, capacity, and reliability and integrity improvements included replacement of deteriorated wooden poles, replacement of degraded line and substation equipment, and customer-driven line and substation expansions. Grid Improvement Plan work, which comprised $613.6 million of the total transmission investment on a system basis through September 30, 2023, included the following:

(1) System Intelligence program, which involves deployment of intelligence and monitoring technology, remote monitoring and control functionality for substation and line devices, and replacement of electromechanical relays with digital relays that include increased functionality;

(2) Transformer Bank and Oil Breaker replacements, to reduce the risk of unplanned failures and customer interruptions;

(3) Substation Hardening and Resiliency ("H&R") projects, which includes deployment of animal resistant fences and targeted replacement of key components within the substation to support a stronger and more resilient transmission grid;

(4) Line H&R projects, create a stronger and more resilient transmission grid capable of withstanding or quickly recovering from extreme external events, natural or manmade. The Transmission Line H&R portfolio includes Cathodic Protection to protect and harden transmission towers from corrosion and degradation. The portfolio also includes projects to rebuild aged and end of life transmission lines segments as well as replace targeted wood transmission poles with stronger steel poles; and

(5) Physical Security projects, which install high security fences, intrusion detection equipment, and other technology to reduce the risk of intrusion to critical substations.

These investments are driven by the continuing influence of the trends identified in our last rate case and discussed in the concurrently filed testimony of Witness Guyton, which continue to be the primary influences on the development and expansion of our Transmission system. As discussed by Witness Guyton, the Grid Improvement Plan investments increase reliability and resilience of the grid, allowing for faster restoration time and less outages

during severe weather events and further protecting the grid from cyber/physical security threats. The costs of our Grid Improvement Plan programs have proven to be generally consistent with the projected costs used in our underlying Cost Benefit Analyses for those programs and our system performance has also benefitted from our investments in these programs through reduced frequency and duration of outages to DEC's system.

DEC also executes a comprehensive vegetation management program across the state that works to proactively maintain trees both within and outside the transmission rights-of-way on regular cycles. This work seeks to improve overall reliability, harden the grid against severe weather impacts, and reduce the impact of vegetation outages across the system.

Overall, the DEC grid is reliable and well-maintained. While the Company has worked hard to maintain the system and reliably meet the needs of customers, we also understand more must be done to improve the state's energy infrastructure to meet the energy challenges and opportunities that lie ahead, and we are committed to that process.

II. DEC'S TRANSMISSION SYSTEM OVERVIEW AND INVESTMENTS SINCE THE COMPANY'S LAST RATE CASE IN SOUTH CAROLINA

Q. PLEASE GENERALLY DESCRIBE DEC'S TRANSMISSION SYSTEM IN THE CAROLINAS.

A. DEC's transmission system delivers electric service to approximately 2.7 million retail customers located throughout a 24,000 square mile service area in western South Carolina and central and western North Carolina, with

approximately 658,000 customers in South Carolina. In addition to its retail customers, DEC also sells electricity at wholesale rates to municipal, cooperative, and other investor-owned utilities.

In addition to power lines and substations, the system includes various other equipment and facilities such as control rooms, computers, structures, transformers, regulators, capacitors, breakers, communication devices, and protective relays. Together, these assets provide the Company considerable operational flexibility with its transmission system and allow DEC to provide safe, reliable, and affordable power to the Company's customers in South Carolina.

Q. HOW IS THE COMPANY ORGANIZED TO MANAGE ITS TRANSMISSION SYSTEM?

A. DEC's transmission grid is managed by coordinating operations, maintenance, and planning activities across the Company's service area. The bulk power system is operated by the Energy Control Center, which handles monitoring, control, and dispatch functions. The transmission infrastructure is maintained by both the Construction and Maintenance and Vegetation Management organizations, who oversee maintenance, construction, and outage response functions in each region. While some functions are regionalized, shared services are utilized for system planning and operations, resource & project management, and engineering and asset management. This design allows the Company to provide quick and responsive support while leveraging shared services where appropriate for the benefit of customers.

Q. WHAT OPERATING AND MAINTENANCE ("O&M") ACTIVITIES ARE NECESSARY TO MAINTAIN A RELIABLE TRANSMISSION SYSTEM FOR DEC'S CUSTOMERS?

A. The Company utilizes vegetation management, ground and aerial patrols of lines, relay and battery testing and calibration, breaker testing, station infrared inspections, and transformer diagnostic testing. DEC monitors outages and their causes to look for reliability trends and improvement opportunities. Our Engineering group, Project Development team, and Construction and Maintenance crews also work to correct any deficiencies found in our system while performing work or designs. During routine station inspections, our crews are tasked with addressing discrepancies while onsite, as appropriate, or reporting back any discrepancies they discover for follow-up.

Q. CAN YOU PROVIDE MORE DETAIL ABOUT THE INVESTMENTS THE COMPANY HAS MADE ON ITS TRANSMISSION SYSTEM SINCE ITS LAST RATE CASE IN SOUTH CAROLINA?

A. Investments in the Company's transmission system have been made to provide capacity to serve system growth, ensure adequate system voltage, support transmission-related infrastructure for both new generation and decommissioning of generation, and improve system reliability. Since our last South Carolina rate case, approximately $1.8 billion has been invested in the transmission system, inclusive of additions through the Grid Improvement Plan, which I discuss in the next part of my testimony.

The chart below illustrates the major categories of the transmission system capital investment over the last almost five years.[1]

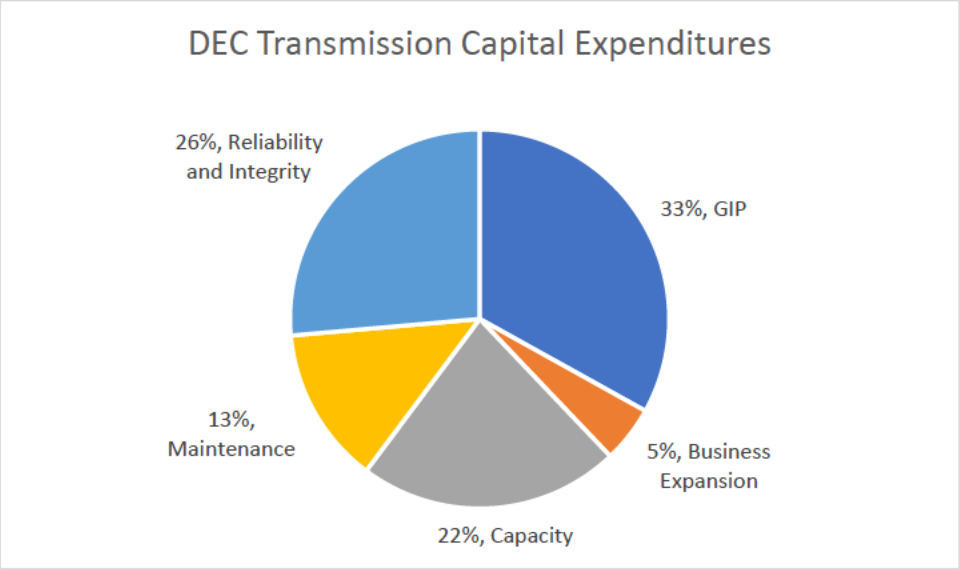

Figure 1

On the transmission system, approximately 33% was the result of the implementation of the Grid Improvement Plan. Approximately 26% of investment in the transmission system was driven by reliability improvement programs, including the replacement and upgrade of deteriorated wood poles with steel, substation reliability upgrades, and physical security improvements. Approximately 22% of investment was driven by capacity requirements to serve load and to meet the North American Electric Reliability Corporation Planning Standards. Approximately 13% of investment was driven by capital maintenance programs, including vegetation management hazard tree removal.

[1] 2019, 2020, 2021, 2022, and through Sept 2023 expenditures. All Transmission plant additions for October 2023 through December 2023 will be updated with actuals in the supplemental testimony of Witness LaWanda Jiggetts.

Finally, approximately 5% of the investment was driven by customer expansion work, which includes projects to support new retail customers as well as network upgrades driven by wholesale customers.

Q. HAS DEC'S TRANSMISSION SYSTEM GROWN SINCE ITS LAST RATE CASE?

A. Yes. The Transmission system has expanded over time to ensure adequate system voltage and capacity, based on projected system loading, and contingency requirements related to providing safe and reliable service to our customers. Transmission system growth has also occurred because of new generation and/or decommissioning of existing generation assets.

Q. PLEASE EXPLAIN HOW DEC'S APPROACH TO TRANSMISSION VEGETATION MANAGEMENT AFFECTS OPERATIONS.

A. DEC's Transmission Integrated Vegetation Management program is focused on ensuring the safe and reliable operation of the transmission system by minimizing vegetation-related interruptions and maintaining adequate conductor-to-vegetation clearances, while ensuring compliance with regulatory, environmental, and safety requirements and standards. The program activities focus on the removal and/or control of incompatible vegetation within and along the right of way to minimize the risk of vegetation related outages and ensure necessary access within all transmission line corridors.

The Integrated Vegetation Management program includes the following activities:

- Planned corridor work which is threat and condition-based;

- Reactive work identified through inspections; and
- Floor management (herbicide, mowing, and hand cutting) within the corridor.

Planned work for DEC is prioritized and scheduled using a threat and condition-based approach identified through remote sensing, inspections, and field assessments while considering other factors such as the date of previous work and outage history. The reactive work is identified through remote sensing and periodic inspections. The floor management is focused on managing the floor of the corridor on a periodic schedule.

Q. IN YOUR OPINION, ARE ALL THE TRANSMISSION FACILITIES INCLUDED IN DEC'S BASE RATE REQUEST USED AND USEFUL IN PROVIDING SERVICE TO DEC'S RETAIL ELECTRIC CUSTOMERS IN SOUTH CAROLINA?

A. Yes. Including the projects that will be completed on or before December 31, 2023, all of the reasonable and prudent additions to DEC's transmission system requested for recovery in base rates are used and useful to its customers in South Carolina.

III. DEC'S GRID IMPROVEMENT PLAN INVESTMENTS AND OPERATIONAL BENEFITS SINCE THE LAST RATE CASE IN SOUTH CAROLINA

Q. HAVE THE TRANSMISSION INVESTMENTS MADE BY THE COMPANY ALLOWED IT TO MEET ITS OPERATIONAL PERFORMANCE GOALS?

A. Yes. DEC's principal goal is to deliver safe and reliable electric service at reasonable prices. We measure this principal goal based on customer satisfaction, safety, and reliability of the Company's transmission system, while responsibly managing operational and capital expenditures for the benefit of our customers.

Q. PLEASE EXPLAIN THE METRICS THE COMPANY USES TO MEASURE THE EFFECTIVENESS OF ITS TRANSMISSION OPERATIONS.

A. DEC Transmission utilizes industry-standard metrics to assess the overall effectiveness of its Transmission operations. Witness Guyton's testimony discusses the System Average Interruption Duration Index ("SAIDI"), which is a measure of customer outage duration and includes transmission system outages. Transmission also uses a specific reliability index metric to measure the performance of the transmission grid. This industry-accepted metric, defined by the North American Transmission Forum, is Outages per Hundred Miles per Year – Sustained Automatic ("OHMY-SA"). OHMY-SA measures the number of transmission line sustained (i.e., ≥ 1 minute) automatic outages that are incurred per hundred circuit miles per year.

Q. HOW HAS DEC'S TRANSMISSION SYSTEM PERFORMED UNDER THESE METRICS?

A. Our system has performed well, and we have continued to provide safe, reliable, and reasonably priced electric service to our customers. While there is still more work to do, these reliability measures indicate DEC is performing well when compared to industry peers, especially in customer outage duration. The trend for the OHMY-SA metric is set forth below with the bar charts representing actual values as well as the dotted trendline.

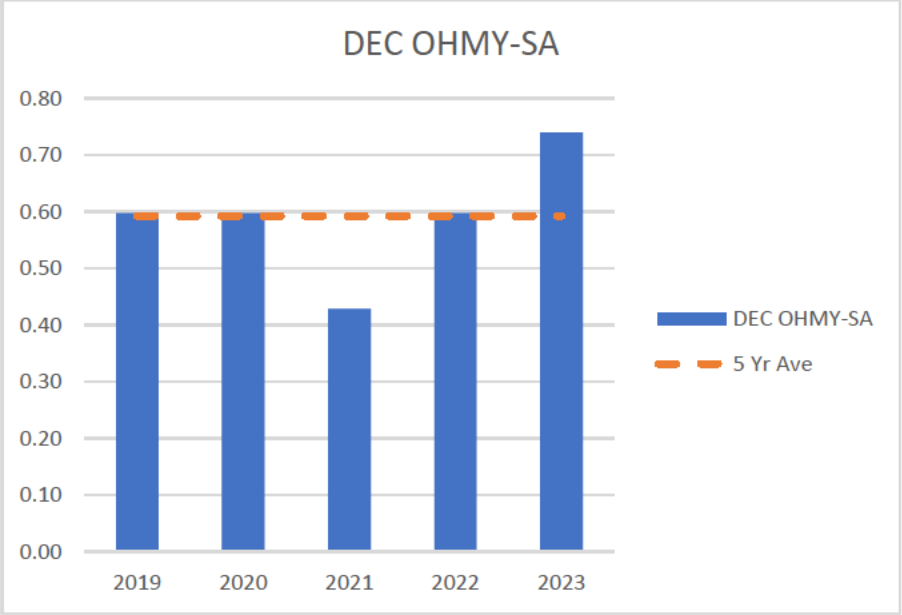

Figure 2 – Duke Energy Carolinas' Historic Transmission OHMY-SA

DEC has been able to sustain consistent OHMY-SA over the past 5 years. The primary drivers of DEC's 5-year OHMY-SA performance are vegetation from outside right of way, animal contact, lightning, and relay and control systems. The outliers in DEC's OHMY-SA performance seen in 2021 and 2023 are a result of factors outside the Company's control such as vegetation from outside

the right of way and public interference events. Figure 3 in Witness Guyton's testimony illustrates the SAIDI trend over the last five years. The primary drivers of DEC transmission's SAIDI performance are vegetation, animal contact, line equipment failures, and transformer equipment failures.

Q. CAN YOU PLEASE QUANTIFY THE TRANSMISSION INVESTMENTS ALLOCATED TO SOUTH CAROLINA SINCE DEC'S LAST RATE CASE UNDER ITS GRID IMPROVEMENT PLAN PROGRAM?

A. Yes. The DEC South Carolina-allocated Grid Improvement Plan transmission investments made since the last rate case total approximately $104.4 million on a South Carolina retail basis. The following table shows the transmission investments made per Grid Improvement Plan program from January 1, 2019 through September 30, 2023.

Grid Improvement Plan Programs ($ in millions)	Plant In-Service 2019-09/30/2023
Integrated Volt/Var Control	**0.3**
Transmission Hardening & Resiliency	**31.0**
Transmission Bank Replacement	**8.1**
Transmission System Intelligence	**15.6**
Oil Breaker Replacement	**10.8**
Enterprise Communications	**10.3**
Physical and Cyber Security - Transmission	**28.2**
Total	**104.4**

Witness Guyton is supporting the DEC South Carolina Grid Improvement Plan distribution investments, including Integrated Volt/Var Control and Enterprise

Communications, which are shown above due to the investments incurring some transmission costs.

Q. HAS THE COMPANY PROVIDED DESCRIPTIONS OF THESE GRID IMPROVEMENT PLAN PROGRAMS?

A. Yes. The Company previously provided program descriptions of these programs in Docket No. 2018-319-E, Oliver Exhibit 4. For ease of reference, I have included these program summaries as Fogg Direct Exhibit 1 – South Carolina Grid Improvement Plan Program Summaries. These summaries also include which grid capabilities each program enables as well as the program's value to customers.

Q. WHAT ARE SOME OF THE OPERATIONAL BENEFITS ASSOCIATED WITH GRID IMPROVEMENT PLAN WORK COMPLETED TO DATE?

A. Each of the transmission H&R sub-programs work to address unique challenges in ways that harden the system to minimize impacts of disruptive, unplanned outages to customers.

The Animal Mitigation subprogram includes installation of animal mitigation fencing at eighteen South Carolina substations including eight substations in the Greenville area and five substations in Anderson. These fences are specifically designed to prevent animal-induced events from impacting customers.

The Physical Security Program is designed to reduce the potential for intrusion to the most critical substations. High security fences and intrusion

detection technology have been deployed at transmission substations across the DEC service territory including Catawba, Newport Tie, Wylie, and Jocassee in South Carolina. These security upgrades reduce the risk of impact to the electric grid from external hazards and improve the ability for Duke Energy to monitor and react to emerging threats.

Transmission Bank Replacement is a predictive and proactive replacement program targeted to reduce the risk of disruptive outages, as well as reduce the impacts and costs of replacement when compared to performing the same work following a catastrophic failure. The power transformer plays a vital role in the transfer of electric energy between Generation and Distribution. During their operating life transformers are exposed to thermal, electrical, and mechanical stresses. The combination of all these stresses contributes to the deterioration of the condition of a transformer. Critical power transformers in poor condition can fail and result in outages to our customers and costly unplanned restoration costs. For this reason, it is important to identify power transformers at risk and replace them under a planned program before they fail. One example of this program work is the Pacolet Tie Bank #2 auto transformer project. This project replaced the current auto transformer with a larger auto transformer doubling the capacity at this substation, which serves as a tie point for seventeen transmission lines in the Spartanburg area.

The Transmission System Intelligence program consists of several types of upgrades designed to enable better protection and monitoring of the transmission grid. The data collected from digital relays and condition-based

monitors helps better assess and optimize transmission asset health. These projects improve reliability for customers by reducing the duration and impacts associated with transmission system interruptions. Installations of intelligent communication equipment have been completed at 25 South Carolina substations (77 DEC system-wide) through September 30, 2022.

The purpose of the Oil Breaker Replacement program is to upgrade these legacy assets with modern breaker technology capable of reliably interrupting system faults and minimizing impacts to customers following events. This program involves replacing outdated transmission oil circuit breakers typically in conjunction with upgrading the transmission relays. For transmission voltages, 69kV and above, the new breakers are modern gas circuit breakers. The program also includes replacing outdated distribution Oil Circuit Breakers, typically in conjunction with upgrading the associated distribution circuit relays. For distribution voltages, 35kV and below, the new breakers are modern vacuum circuit breakers. The enhanced communication and control capabilities of this technology better positions the transmission and distribution systems to work with grid automation systems for responding to electric grid events. Breakers were upgraded at eight substations in South Carolina which improved reliability for approximately 20,000 customers.

The Company has also shared progress made to-date on 2019-2022 South Carolina Grid Improvement Plan program projects with interested South Carolina stakeholders as discussed later in my testimony.

Q. HAVE THE UNDERLYING ASSUMPTIONS OF THE ORIGINAL COST BENEFIT ANALYSIS PERFORMED FOR GRID IMPROVEMENT PLAN PROGRAMS SIGNIFICANTLY CHANGED?

A. No. While some programs have experienced cost variations, the basis used to estimate the benefit to the customers from these investments remain sound. The Grid Improvement Plan programs were identified and implemented to address the seven "Megatrends" impacting Duke Energy's grid in South Carolina as previously described in Docket No. 2018-319-E and summarized in Witness Guyton's testimony.

Q. HOW HAS THE COMPANY ACCOUNTED FOR TRANSMISSION GRID IMPROVEMENT PLAN-RELATED COSTS?

A. As is explained in the testimony of Witness LaWanda Jiggetts, the Company has recorded the incremental Operating and Maintenance ("O&M") costs, depreciation and property taxes associated with the Grid Improvement Plan programs to a regulatory asset account, as well as the carrying cost on the investment and on the deferred costs at DEC's weighted average cost of capital consistent with Order No. 2018-751.

Q. HAS DEC COMPLETED ITS GRID IMPROVEMENT PLAN ACROSS THE STATE OF SOUTH CAROLINA?

A. No. Additional work is needed for the Company to complete the entire scope of its Grid Improvement Plan programs. In fact, as Witness Guyton explains in his testimony, the Company shared preliminary plans for 2024-2026 South

Carolina Grid Improvement Plan work with interested stakeholders in the fall of 2023 and filed information in Docket No. ND-2020-28-E.

Q. IS THE COMPANY PROPOSING THAT THE COMMISSION APPROVE ITS GRID IMPROVEMENT PLAN PROGRAMS ON A GOING FORWARD BASIS IN THIS DOCKET?

A. Not in this proceeding. The Company has filed a Petition in Docket No. 2023-403-E asking that the Commission extend its deferral for Grid Improvement Plan work to optimize, modernize and protect the grid, for continuing DEC Grid Improvement Plan Projects undertaken beginning January 1, 2024, through the rate effective date of DEC South Carolina's next general rate case following this proceeding.

Q. HAS THE COMPANY SHARED PROGRESS ON GRID IMPROVEMENT PLAN WORK WITH INTERESTED STAKEHOLDERS IN SOUTH CAROLINA?

A. Yes. As stated in Witness Guyton's testimony, the Company hosted several virtual forums periodically since 2018 to inform interested stakeholders on progress made on the Grid Improvement Plan, provide program and project highlights, as well as take questions and feedback from attendees. These presentations, reports and corresponding lists of forum attendees can be found in Guyton Direct Exhibit 2 through Guyton Direct Exhibit 9.

Q. DO THESE EXHIBITS ONLY CONTAIN INFORMATION ABOUT DEC?

A. No. As Witness Guyton explains, Duke Energy created a plan for the grid in South Carolina, and that included both DEC and DEP. I believe it is important to discuss plans and results jointly as we think of the needs of customers in the State. Moreover, I believe it facilitates better discussions among parties and entities who have an interest in both service territories to see the material presented together. The variance reports included within these exhibits do have discrete DEC program and project details.

Q. WILL THE COMPANY CONTINUE TO ENGAGE WITH PARTICIPATING STAKEHOLDERS ABOUT ONGOING GRID IMPROVEMENT PLAN DEPLOYMENT WORK?

A. Yes. As stated in Witness Guyton's testimony, we expect to have continuing dialogue with interested parties on the Company's Grid Improvement Plan, how it benefits and affects those interested parties, and to continue to bring those findings to the Commission.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.